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ABSTRACT

This paper recognizes that critics of the "plain language movement" point out that what is "plain" to one audience may mystify and confuse another. It adds that questions such as "Plain language for whom?" and "How can we know whether a text is written in plain language?" raise legitimate concerns about the danger of ignoring the fact that what is "plain" is relative to the particular audience reading and/or using a text. The paper addresses these questions by illustrating a concrete and empirically tested procedure for revising texts to meet the needs of expert or lay audiences. Specifically, the paper details protocol-aided revision--a procedure which employs readers' responses to texts to guide revision activity--and demonstrates why actual reader feedback is the most sensible and effective criterion for deciding whether a text is written in plain language. It provides two case studies of texts that were revised for comprehensibility using protocol-aided revision, underscoring the point that plain language is more than verbal text alone; it includes effective integration of visual and verbal text. The paper also presents a cognitive model of the process of protocol-aided revision. The paper may interest both proponents and critics of plain language because it argues for a redefinition of plain language and suggests a method for assessing if plain language goals have been met. Nine figures of original texts, user protocols, protocol aided revisions, and sample reading protocols are included, and 57 references are attached. (Author/PRA)

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Center for the Study of Writing

Technical Report No. 46

PLAIN LANGUAGE FOR EXPERT OR LAY AUDIENCES: DESIGNING TEXT USING PROTOCOL-AIDED REVISION

Karen A. Schriver

February, 1991

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Karen A. Schriver

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University of California
Berkeley, CA 94720

Carnegie Mellon University
Pittsburgh, PA 15213

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Abstract

Critics of the "plain language movement" point out that what is "plain" to one audience may mystify and confuse another. Questions such as "Plain language for whom?" and "How can we know whether a text is written in plain language?" raise legitimate concerns about the danger of ignoring that what is "plain" is relative to the particular audience reading and/or using a text. This paper addresses these questions by illustrating a concrete and empirically-tested procedure for revising texts to meet the needs of expert or lay audiences. Specifically, this paper details protocol-aided revision—a procedure which employs readers' responses to texts to guide revision activity—and demonstrates why actual reader feedback is the most sensible and effective criterion for deciding whether a text is written in plain language. It provides two case studies of texts that were revised for comprehensibility using protocol-aided revision, underscoring that plain language is more than verbal text alone; it includes effective integration of visual and verbal text. This article also presents a cognitive model of the process of protocol-aided revision. This paper may interest both proponents and critics of plain language because it argues for a redefinition of plain language and suggests a method for assessing if plain language goals have been met.

PLAIN LANGUAGE FOR EXPERT OR LAY AUDIENCES: DESIGNING TEXT USING PROTOCOL-AIDED REVISION

Karen A. Schriver
Carnegie Mellon University

INTRODUCTION

People who argue against the "plain language movement" point out that what is "plain" to one audience may mystify and confuse another. Questions such as "plain language for whom?" and "How can we know whether a text is written in plain language?" raise legitimate concerns about the danger of ignoring that what is "plain" is relative to the particular audience reading or using a text. Up to this point, plain language proponents have not sufficiently addressed the issue of defining plain English. This lack of definition has fueled critics of the movement to argue that plain language is so loosely defined that it can mean anything from the process of simplifying complex sentence structure to the wholesale rewriting of documents. Critics from the areas of medicine, law, and government are worried that plain language will be translated as "dummying down" their documents. They are legitimately concerned that people without subject-matter expertise will decide what language will be considered technical and that such people may misinterpret or actually change the meaning of documents with legal or medical implications (MacNeil/Lehrer Report, 1978).

While both proponents and critics agree that, in theory, plain language could be very beneficial, the questions remain, "What is plain language?" and "Will all readers benefit from plain language?" The purpose of this paper is to suggest that plain language can be defined and that specific methods exist for insuring a text's clarity for its intended readership. Through cases studies of the revision process of several texts, this paper provides evidence that plain language can indeed benefit all audiences, whether expert or lay. Thus, the definition of plain language will be extended to creating clearly written and usable texts that suit the unique needs and purposes of both subject-matter novices and subject-matter experts. This paper will show why collecting reader feedback in response to a text is the most effective test for judging whether it is plain for the intended audience. Specifically, this paper will detail "protocol-aided revision," a procedure which uses reader feedback to guide revision of texts for comprehensibility and usability. In addition, this paper will stress that plain language is more than verbal text alone; it includes effective integration of text and graphics. Finally, this paper provides a model of the protocol-aided revision process, illustrating how protocols can help writers modify text to meet the special needs of particular audiences.

THE PROBLEM IN DEFINING "PLAIN ENGLISH"

In 1979, Veda Charrow asked proponents of the plain language movement, "What is plain English, anyway?" Charrow answers this question indirectly, asserting that "although most of us would probably not agree on what plain English is, we could probably agree on some aspects of what it is not" (Charrow, 1979, p. 2). Charrow explicates the variety of ways that advocates have defined plain English, citing that it is not "legalese," or "plain, ordinary peoples' language," or "texts that are written with short sentences and simple words" (Charrow, p. 3). Early advocates such as Charrow spent a great deal of time trying to address the needs of at least four distinct audiences for plain language: (1) consumers, (2) critics, (3) government officials, and (4) writing and reading researchers. Each audience had a different set of concerns regarding a definition. Consumers wanted it to mean that they would be able to understand and use the documents

they read and sign. Critics wondered if plain language meant "elimination of all technical words" and worried about its implications in the marketplace, its ramifications for creating and revising public documents, and its effect on texts that were intended for lay and/or expert audiences (MacNeil/Lehrer Report, 1978, pp. 4-5). Government officials wanted to know what a plain language law would look like and what enforcement would involve. Writing and reading researchers wanted to know if there were ways to verify whether a document was written in plain language; they wanted to move plain language beyond the slogan stage and to create a research agenda involving how people read and understand functional documents such as textbooks, contracts, procedural texts, informational brochures, forms, leases, consumer product information, or computer manuals (Felker, 1980; Hartley, 1978).

At the same time advocates were trying to define plain language, they were also trying to educate consumers. During the late 1970s, advocates of plain language were trying to inform the public that confusing and hard-to-understand public documents did not have to be the norm, that there were alternatives to medicalese, legalese, and bureaucratese. Consequently, most effort in the late 1970s in Britain and in the United States was devoted toward raising the consciousness of consumers that they indeed have a right to demand plain language. Early advocates provoked controversy by arguing that unclear and purposefully vague and jargon-laden language was being used as a tool to keep the less knowledgeable, less powerful, less wealthy, from knowing what they were signing.

When plain language came to the public's attention, there were very few publications concerning the nature of document design and writing processes. There was also very little consolidated research on how people read and use public documents. (For a review of recent literature on document design, see Schriver, 1989b.) Part of the mission of early publications such as *The Information Design Journal*, *Visible Language*, and the American Institutes of Research newsletter, *Fine Print*, (now *Simply Stated)*, and Carnegie Mellon University's *Communications Design Newsletter* was to inform researchers, educators, and practitioners of new findings on document design research as well as to provide a forum for raising plain language issues. However, before writing and document design research had time to clarify the goals of plain language, thus allowing it to be defined more convincingly, lawyers and government officials were wrangling over its definition on American television (see, for example, The MacNeil/Lehrer Report, "Plain English," 1978).

It is unfortunate that plain English got off to such a confused start. Almost every country which has advocated plain language has found itself in the position of needing to clarify what it is and is not. The following characterization of plain language created by Australia's Law Reform Commission of Victoria (1986) demonstrates the continued need to clarify the nature of plain English:

> Plain English is a full version of the language, using the patterns of normal, adult English. It is not a type of basic English, or baby-talk. While documents that are converted to plain English may be described as *simplified*, they are simplified in the sense of being rid of entangled, convoluted language—language that is difficult to analyze and understand, language that submerges, confuses and conceals its message. They are simplified in this sense, and not in the sense that the language has been severely condensed or amputated and the message truncated. Plain English is not artificially complicated, but it is clear and effective for its intended audience. While it shuns the antiquated and inflated word, which can readily be either omitted altogether or replaced with a more useful substitute, it does not seek to rid documents of terms which express important

> distinctions. Nonetheless, plain language documents offer non-expert readers some assistance in coping with these technical terms. To a far larger extent, plain language is concerned with matters of sentence and paragraph structure, with organization and design, where so many of the hindrances to clear expression originate. (Law Reform Commission of Victoria, 1986, p. 3)

This characterization makes two important points about the goals of plain language. First, to meet goals of plain language does not mean condescending to the reader. Second, writers and designers of plain language documents intend neither to eliminate nor to hide complex ideas or technical terms in documents. These points are important ones that need to be reinforced and demonstrated before the goals of plain language will be understood by its critics.

One drawback of the Victoria Commission's characterization, however, is that it appears to limit the scope of plain language to a focus on documents written for non-expert readers (that is, lay audiences or low-literate readers). Yet it is clear that many documents intended for expert audiences also fail to meet the expert reader's needs. For example, in a recent case before the United States Circuit Court in Dade County, Florida, a woman sued a medical equipment company for physical injuries that were caused by the malfunctioning of a device called a "programmable neurostimulator" (Garner vs. Cordis, 1987). This device is designed to block the pain associated with damage to the central nervous system by sending mild electronic impulses to the damaged nerves. When properly implanted, the device relieves pain. However, if improperly implanted, the device can create extreme pain and cause more damage to the nervous system. The woman (Garner) sued the company arguing that due to a malfunction of their equipment, she was left with severe spinal cord damage. The company (Cordis) presented a counter argument that the problem was caused by the physician who improperly implanted the device too deeply beneath the skin. Cordis claimed that their manual gave clear procedural information regarding how deep to implant the device and that the fault was with the physician.

The doctor's counter argument was that critical information on the depth of implanting was not clearly written nor was it located in a visually prominent place in the manual. The physician argued that the documentation did not warn physicians that "if implanted too deeply, it could misfire . . . possibly damaging the spinal cord" (Garner vs. Cordis, 1987, pp. 40-41). The question then became one of whether the documentation was written in plain language for the expert and whether the important information was well designed for the expert. An expert witness (Duffy) who evaluated the adequacy of the documentation found that indeed the text did not clearly state the consequences associated with implanting the device too deeply. Furthermore, the text did not use bold face, highlighting, or graphic features to warn physicians of the dire consequences associated with implanting the device too deeply (Garner vs. Cordis, pp. 48-49).

In other professional work environments such as that of managing a computer center, poorly designed paper and online computer documentation has been found to cost experienced system programmers valuable time and energy because of incomplete, inconsistent, and hard-to-locate information (Norman, 1981; Schriver & Hayes, in preparation). Similarly, the United States General Accounting Office describes a radar manual in which experienced technicians had to refer to 165 pages in eight documents and to look in 41 different places in those documents to repair one malfunction (Duffy, Post, and Smith, 1987; General Accounting Office, 1979). There is also evidence that expert pilots in the United States Air Force perform less efficiently with traditional manuals than they do with manuals that give precise, step-by-step instructions (Hatterick & Price, 1981, p. 77).

But expert audiences usually need more than accurate and logical procedural information; they need text that is designed to facilitate high-level problem-solving. The late Judith Resnik, astronaut of the U.S. Challenger Mission, reports that astronauts found the documentation for their training to be comprised of plodding procedural instructions that provided little assistance for the sophisticated problem-solving required of flight engineers under actual conditions (McKay, Petro, Magin, & Resnik, 1985). She argues that astronauts need to understand more than just which button to push or even which contingency procedures to follow because they need to be able to apply their understanding to the unexpected problems of each particular mission.

What experts seem to want most are detailed examples of operations or situations they might find themselves in; thus, experts can use either the examples directly, modify them for the particular task at hand, or draw implications from them and derive their own solution. McKay, Petro, Magin, and Resnik (1985) underscore the importance of well-constructed examples in texts written for experts and the need for instructional text to promote active learning.

And like the manual written for the surgeon described above, McKay, Petro, Magin, and Resnik point out that training manuals written for astronauts have both content and document design problems. They present examples of "Orbital Maneuvering" manuals produced with type size as small as three points; long sections of text printed in capitalized letters; schematics and diagrams of complex equipment that are small and hard to read and that are not placed near the text which describes them. Overall, they assert that training materials written for astronauts contain a variety of visual and verbal text that is not integrated in any meaningful way.

When texts are redesigned for the intended audience's particular needs, the changes can have a dramatic effect on how the audience will respond to the text. Ayoub, Cole, Sakala, and Smillie (1974) found that system analysts and engineers improved in their performance when the manuals were redesigned for expert use. Moreover, Robert Eagleson, the Australian government's Special Advisor on plain language, reports that putting forms and documents into plain language (many of which are used by experienced clerical and supervisory staff) has saved business and government thousands and sometimes millions of dollars (*Simply Stated*, 1986, pp. 1-4).

The common theme in these examples is that like texts written for lay audiences, texts aimed at experts are also often both poorly written and poorly designed. Examples such as these make it clear that a working definition of plain language must include expert as well as lay audiences. *A well written text in plain language, then, is one which enables the intended audience, whether expert or lay, to comprehend and use the text effectively.*

THE IMPORTANCE OF READER FEEDBACK

Since the 1940s, writers and document designers have been looking for ways to verify the success of public documents and many techniques have been developed to aid the document evaluation process. The most widely used techniques, readability formulas such as those of Flesch (1949) and Gunning (1952), rely on counting the number of words and syllables per sentence to determine a document's readability. These techniques are by definition text-based, that is, they focus solely on surface-level text features and not on how readers respond to the texts (see Schriver, 1989c, for a discussion of this issue). Tests of this sort have been shown to have severe limitations for guiding the revision of texts that are effective and usable (Duffy & Waller, 1985). While such tests can provide gross clues suggesting which sentence-level features may be problematic, their output

provides little, if any, information about how the document is working at the paragraph and whole-text level. In fact, when such text-based tests are used as the only guide for revision, revisors may actually make the text worse instead of better (Swaney, Janik, Bond, & Hayes, 1981).

Successful revision has been shown to depend on the writer's ability to anticipate the needs of a reader and to identify ways to help clarify whole-text problems from the reader's perspective (Flower, Hayes, Carey, Schriver, & Stratman, 1986; Hayes, Flower, Schriver, Stratman, & Carey, 1987; Schriver, 1987, 1989a; Sommers, 1980). To revise a document for a particular audience requires that writers recognize and predict the diverse goals and reading strategies that people may bring to the process of understanding and using a functional document.

Readers have been found to bring a wide variety of goals, purposes, assumptions, and reading strategies to their comprehension and use of functional texts. Some of the goals and purposes readers may bring include reading to:

1. do a task, e.g., filling out a form for a loan application;

2. understand an idea, a concept, or definition, e.g., reading to understand one's rights in a legal contract;

3. find information quickly, e.g., trying to find a procedure in a user's manual for operating a computer;

4. assess the relevance of a text, e.g., reading a brochure which describes the conditions for a tax rebate;

5. interpret and use the information for a purpose other than the text's intended purpose, e.g., reading a computer manual to solve a problem that is not described in the text, but that may be solved by analogous means;

6. refresh one's memory about a fact, procedure, or idea that is vaguely remembered, e.g., reading a reference manual for a telephone answering machine to retrieve a fact about remote dialing;

7. make a decision about choices or alternative ways to consider the same idea, e.g., reading a pamphlet that describes the pros and cons of building a nuclear power plant.

To determine if a document is meeting the goals and purposes of the intended audience, writers need more feedback than text-based tests can provide. Writers and document designers have found standard writing advice too simplistic to guide the revision of the complex documents they create. Writers want more than vague maxims such as "choose a suitable design and hold to it" and "avoid fancy words" (Strunk & White, 1979, pp. 15 and 76).

Today's writers and document designers are often faced with a range of decisions, most of which are not at the sentence-level—decisions such as whether to present the text on paper or via online; how to organize the text to promote rapid retrieval of information, or how to choose optimal graphic devices to help clarify the text's structure and meaning. Instead of abstract "elements of style," writers are looking for answers to concrete questions concerning how well the text is functioning for the intended audience.

As audiences become more specialized and more educated in technical areas, they expect documents that are not designed "for everyone," but rather, are targeted to their particular needs. In many industrial and corporate document design contexts—computer, electronics, and appliance industries, for example—writers must tailor their texts to very particular audiences. The ability to adapt texts for audiences who are novices, intermediates, or experts in a particular subject-matter is rapidly becoming a requisite skill in industry.

Writers are finding that the best way to evaluate the success of a functional document is perhaps the most obvious: observe readers while they try to understand and use the document. An effective revision procedure that uses the feedback of readers while they are engaged in the process of comprehending and using a text is protocol-aided revision, a method developed in 1980 by researchers at Carnegie Mellon University's Communications Design Center.

WHAT IS PROTOCOL-AIDED REVISION?

While protocol analysis as a method for studying cognitive processes has been widely discussed in the literature (see, for example, Ericsson & Simon, 1984) the use of protocols to guide reader-based revision of functional documents has not. Protocol-aided revision is a method for helping writers see problems in text that they might otherwise miss. It involves using readers' comprehension and performance difficulties as the basis for revision activity. It is a cyclical activity in which each cycle consists of readers responding to a text and a writer using readers' responses to guide revision. The next nine sections of this paper are intended to help the reader understand how to use protocols in revision. These sections will cover the following topics: the nature of protocols and their functions, designing protocol tasks, selecting participants for a protocol task, creating instructions, practical issues in collecting protocols, transcribing, summarizing, and coding protocols, and finally, fixing problems uncovered by participants.

The Nature of Protocols

A protocol is a record of events, thoughts, or behaviors that occur over a period of time. The record is usually obtained by using a videotape, an audiotape, or a computer program which monitors a person's interaction with a machine. Protocol analysis is a method for tracing a person's thinking or performance on a task. Psychologists, decision-making theorists, writing researchers, and document designers are among those who have used protocol analysis to study how people think as they engage in activities such as solving chess problems (Simon & Gilmartin, 1973); making decisions in supermarkets (Payne & Ragsdale, 1978); planning, writing, or revising text (Berkenkotter, 1983; Flower et al., 1986; Hayes & Flower, 1980; Hayes et al., 1987; Schriver, 1987, 1989c; Smagorinsky, 1989); or using computer manuals (Bond, 1985; Schriver, 1984).

Generally, there are two categories of protocols which have relevance to writers and document designers: behavior protocols and thinking-aloud protocols. In behavior (or motor) protocols, the writer/document designer watches participants as they interact with and use texts such as forms, contracts, procedural instructions, or computer documentation, recording their actions and behaviors. The primary feature of this type of protocol is that participants do not talk aloud while performing a task—they simply do the task while either a document designer or a computer program records what they do. Typically, writers/document designers collecting behavior protocols are interested in such issues as: where readers look for information (in indexes, in tables of contents, in glossaries; how quickly people can find information (in searching for information online); how users make errors and recover from them while operating machinery; how features

such as color, windowing, or display rate influence people's ability to use computers; or how quickly and accurately people can perform a task while using a set of instructions (using a manual to assemble a bicycle).

Behavior protocols include eye movement studies, keystroke logs, and user-edits. Eye movement studies have been used by document designers to determine the effect of colors, display rate, and cursor movement in online documentation and interface design. Keystroke logs, which can be collected automatically during interaction with a computer, provide detailed information about users' error and error-recovery patterns. User-edits, first described by Atlas (1981) involve having users try to work with a machine, using only its manual as a guide.

In thinking-aloud protocols, on the other hand, participants are asked to perform a task while thinking aloud as they interact with a document and/or with a machine. When people experience difficulty in comprehending or in using the document, their comments typically reveal the location and nature of the difficulty. Unlike participants in behavior protocols, think-aloud participants are asked to verbalize anything that comes to their mind as they are engaged in the task. Because thinking-aloud protocols are collected while the person is reading and is engaged in the process of comprehension, they provide much more explicit and complete information than do readers' comments collected after reading is finished. Hayes and his colleagues introduced the use of thinking-aloud protocols to basic research in comprehension and writing processes (Hayes & Flower, 1980, 1983; Hayes & Simon, 1974; Hayes, Schriver, Blaustein, & Spilka, 1986; Hayes, Waterman, & Robinson, 1977), as well as to applied research in writing and document design (Bond, Flower, & Hayes, 1980; Hayes, 1982; Swaney et al., 1981).

Typically, the constraints of practical situations require writers/document designers to choose between these two types of protocols, depending on their goals and purposes in evaluating a text. Since each type of protocol gives the evaluator a different window on the text, it is important to clarify one's purpose in evaluating the document before selecting a method. Behavior protocols are often employed when the purpose of evaluation is to determine how quickly and accurately people can use a text. Think-alouds are frequently used when the goal is to assess how people understand, solve problems with, draw inferences about, use, or read texts.

Think-alouds are not advisable when the evaluator needs precise measures of speed in completing a task, mainly because verbalizing one's thoughts will increase the participant's total time. In addition, think-alouds may be a waste of time when the knowledge or strategies participants will likely employ are tacit, that is, when knowledge or procedures are so well-known that participants use them unconsciously and therefore do not verbalize about them. While think-aloud protocols do not give the evaluator a complete picture of the participant's thinking process as he or she completes a task, they do provide a view which is often much more detailed and informative than is provided by any other method.

Behavior protocols, on the other hand, are not the best choice when the goal is to debug a text for comprehensibility and usability. Behavior protocols, for example, often fall short of providing the writer with the kind of information most needed to revise. Writers and document designers interested in *where, how, and why readers make errors in using or in understanding a text* will find only the grossest clue for answering these questions with behavior protocols. A person using a computer, for instance, may make an error in issuing a command—a behavior that can easily be recorded with a keystroke protocol. The revisor, however, needs to know why the error occurred. Did the person make the error because of: (1) a slip of the finger, (2) a misreading of the correct

command, (3) a missing instruction, (4) a poorly-worded instruction, (5) a faulty inference about what the instruction meant, (6) a misunderstanding of an example within the instruction, or (7) inaccurate, incomplete, or misleading feedback from the system itself?

The advantage of think-alouds is that participants often say how and why they are having a difficulty with the text. Therefore, the writer has both locative and diagnostic information that will help guide revision decisions. Knowing how many minutes it takes for a person to use a text does not really give writers information about how and where to revise the text.

Writers and document designers have many alternatives in choosing methods to evaluate a text. They may want to choose the single most informative method or they may want to choose the best set of converging measures. More than one kind of feedback on a document will provide the revisor with more complete and reliable information on which to base revisions aimed at improving the quality of the text for the intended audience(s). Alternative measures include reader feedback methods such as behavioral or "think-aloud" protocols, retrospective questionnaires, scaled surveys, discourse-based interviews, or a critical incident reports. Revisors may also employ text-focused methods such as the Flesch or Gunning readability scores. The advantage of the reader feedback methods is that because they elicit the response of an actual audience, they tend naturally to be more sensitive to differences between expert and lay audiences than do the text-focused methods.

An important factor in deciding the kind(s) of reader feedback to use is whether the method is *concurrent*, that is, elicits feedback during reading, or retrospective, that is, elicits feedback after the participant has finished reading the document. The primary difference between concurrent and retrospective feedback is that concurrent measures capture the real-time problem-solving behaviors of readers, while retrospective measures rely on the reader's after-the-fact reporting of events. Concurrent reader feedback tests include both behavior and think-aloud protocols, such as eye movement protocols, keystroke protocols, user-edits, thinking-aloud verbal protocols. Retrospective reader feedback tests include questionnaires, surveys, discourse-based interviews, critical incident techniques, and reader opinion cards.

While retrospective procedures can provide extremely useful data, researchers agree that concurrent measures provide the most reliable data. Over the past seven years, many writers, document designers, teachers, and researchers have asserted that behavior and think-aloud protocols are the most sensitive ways to evaluate the quality of a functional document (Atlas 1981; Bond, 1985; Bond et al., 1980; Dieli, 1986; Lund, 1985; MacKenzie & Gerdes, 1987; Mills & Dye, 1985; Roberts & Sullivan, 1984; Schriver, 1984, 1987, 1989c; Schriver et al., 1986; Soderston, 1985; Swaney et al., 1981; Winbush & McDowell, 1980; Winkler, Ferguson, & Youngquist, 1985; Witman, 1987).

Protocol-aided revision is now a widely-used evaluation method in many human factors and testing labs across the country (Lewis, 1983). Soderston (1985), for example, provides a detailed account of the usability edit conducted at IBM Kingston's Human Factors Laboratory; she argues that this procedure consistently reveals gaps and ambiguities in texts that have already gone through many technical reviews. Similarly, Lund (1985), from the Control Data Corporation, describes using "the candid camera approach" for evaluating the user interface of a new interactive graphics application. In addition, protocol-aided revision is now taught in undergraduate and graduate courses in document design and professional and technical writing at the college and university level (Roberts & Sullivan, 1984; Schriver, 1984, 1987). Moreover, protocol-aided revision, which employs think-alouds to isolate problem areas in documents, is an extremely effective means for revising for comprehensibility.

Designing an Evaluation Using Protocol-Aided Revision

Before conducting protocol-aided revision, writers/document designers will need to specify just what is expected from participants; that is, they will need to specify what participants will read or do. A primary consideration is to select a task (or tasks) which will best evaluate whether the document's goals for the audience are being met. For example, if the text is a reference manual, the task should test how successfully people are able to retrieve information from sections such as the index or the table of contents and then find the information in the main body of the text.

In addition to deciding the participants' task, writers/document designers must determine whether participants will read all of the text or just sections of it. If the text is too lengthy to conduct a complete evaluation, it is usual to isolate a section (or sections) to be evaluated. In so doing, it is important to select portions of the document that may be most sensitive to revealing how the document is functioning for the audience. It is useful to evaluate the least complex sections of the text as well as the most difficult. Furthermore, if the text has a table of contents or an index, these sections should be tested. This will allow the writer/document designer to see how people respond to the varying degrees of difficulty within the document as well as to the document's access features. It is recommended that the task should take the participant no more than one hour to complete; otherwise, the test results may be altered by the participant's fatigue.

In creating a context for the task, many writers/document designers use the "scenario approach" involving giving participants a concrete goal for doing the task. For example, suppose the writer of a medical brochure describing the advantages and disadvantages of various surgical procedures wanted to know if readers clearly understood their options. The scenario provided to protocol participants might be: "Imagine you are about to make an important decision about which surgical procedure to choose for your mother. Your goal in reading this brochure is to determine what decision to make based on the information provided." Usually, providing participants with a concrete goal or purpose will lead them to take a active role in reading and understanding the text. When participants have no goal or purpose in reading the text, they sometimes take a more passive role in their reading and understanding, tending to monitor their comprehension less often, thus verbalizing very little.

Selecting participants for the protocol task. To evaluate a document for its intended audience requires that participants in protocol-aided revision be members of (or at least share a great deal in common) with the intended audience. Before selecting participants for a protocol task, create a profile of the intended audience, for example, age, experience level, background, reading ability, attitudes, knowledge of technology, and so on. In general, it is a good idea to determine how much the participant knows about the topic as well as the participant's attitudes, preferences, and biases about the topic. If the audience profile is complex, it may be important to create a screening survey to insure that participants' backgrounds best match the profile, for instance, an experienced UNIX user, with five years of programming, who knows at least two other systems, and who prefers online documentation. For an example of a well-constructed participant screening survey, see Borenstein's (1985) study of online help systems.

One of the most frequent questions writers ask about protocol-aided revision is, "How many participants should I recruit?" While there are no definitive answers, a few suggestions can be made. First, keep in mind that the goal in recruiting participants is to gather a variety of responses to the text rather than to ensure statistical reliability. It is important not to confuse protocol-aided revision with an experiment—its goal is neither

hypothesis testing nor verification. Rather, it is aimed at debugging poorly-written text. Second, while collecting even one protocol is better than no protocol, one may be highly idiosyncratic and unrepresentative of the larger intended audience. The important question is, How small can your participant sample be and still be useful? In practice, document designers at the Communications Design Center have found that five participants per cycle has proved a useful number in conducting protocol-aided revision.

While a single cycle of protocol-aided revision is typically very helpful in comparison to other revision techniques, it is wise in most cases to use several cycles. A rough rule of thumb is that the first pass finds about half of the reader's problems, the second pass half of the remaining problems, and so on. Most documents can be revised to meet the reader's needs in two or three cycles. For each revision cycle, five new participants should be recruited. One should avoid asking the same person to provide a protocol on a document (or task) more than once.

Creating instructions. In conducting protocol-aided revision, it is essential to create well-written instructions. Poor instructions will increase the likelihood that participants will misunderstand or freely interpret the task. The instructions you create will vary depending on the type of protocol best suited to helping you find the difficulties in the document. Either of two types of thinking-aloud protocols are generally useful in most document evaluation contexts: *reading* protocols or *user* protocols. A reading protocol differs from the latter in that the participant uses only the text in completing the task, for example, reading an informational brochure or an insurance policy. In user protocols, participants interact with machine, device, or piece of equipment, for instance, a computer, as they perform the task. This difference becomes important because a participant providing a user protocol will need to look at the document and the equipment alternatively. To know what the participant is focusing on, it will be important to provide instructions that mention talking aloud while using either the text or the machine as they are completing the task. In addition, unless told, participants may think the task is to test their ability to use the equipment rather than to test the manual. Similarly, reading protocol participants may think the task is to test their reading ability or their knowledge and opinions of the subject matter. Below are typical sets of instructions for reading and user protocols.

Typical instructions for a reading protocol

> Thank you for agreeing to participate in providing a think-aloud reading protocol. The goal of this task is to help writers revise the document according to what readers like you need. The reading protocol you provide will help writers see how well or how poorly the text works for a reader. We are *not* testing how well you read. We are *not* testing your knowledge or opinions of the subject matter. Rather, we are testing how *the text* might be improved for a reader with background knowledge and experience such as you have. Please read the text aloud and say anything that comes to your mind as you are reading. Do not worry about what you say, but do keep talking. You do not have to describe how to fix the text problems you may see. Just respond to the text, noting when you do not understand or when the text creates confusion.
>
> Please remember to speak loud enough so that your voice will be recorded. If you fall silent, I will ask you to "please say whatever you are thinking right now." Thank you.

Typical instructions for a user protocol

Thank you for agreeing to participate in providing a think-aloud user protocol. The goal of this task is to help writers revise the document according to what readers need when their goal is to use a document to help them to complete a task. The user protocol you provide will help writers see how well or how poorly the text functions for a reader while engaged in performing the task. We are *not* evaluating your reading ability or your skill in performing the task. Rather, we are testing how *the text* might be improved for someone with background knowledge and experience such as you have. In a few minutes, I will explain the task. In providing a user protocol, simply do the task, using the document whenever and in whatever way you see fit in completing the task. As you are engaged in performing the task, please say anything that comes to your mind as you are reading or doing the task itself. Do not worry about what you say, but do keep talking. When you refer to the text, please read the text you are looking at aloud. Do not worry about describing why you are completing the task in a certain way; just complete the task as best you can, noting when the text is not helping.

Because I am interested in how you use information from the text, I will not be able to answer any questions during your reading. Please remember to speak loud enough so that your voice will be recorded. If you fall silent, I will ask you to "please say whatever you are thinking right now." Thank you.

Preparing to Collect a Protocol: Some Practical Issues

To collect a protocol, you will need the following:

1. A set of clearly-written instructions that can be given to each participant. Writers/document designers should note that the instructions can make or break your protocol testing. Be certain to pilot test your instructions for clarity with at least two people before conducting a formal protocol. The important question is, Do participants interpret the task as I planned them to?

2. Recording equipment (audio, video, or computer-based). This can be as humble as a typical cassette tape recorder to as lavish as equipment found in sophisticated testing labs—such recording equipment might include several video cameras; an eye-tracking camera; audio, dubbing, mixing equipment; a time-stamping program; as well as keystroke-tracking programs.

3. A place to conduct the protocol. Depending on your goals, you will want to test the document in either its actual environment (on the plant floor or in a busy office) or under quiet, laboratory-like conditions.

4. The equipment described in the text if collecting a user protocol. That is, any other equipment needed to conduct the protocol, depending on the document you are testing (for instance, if the document is a set of instructions for using a cuisinart, you will need a cuisinart).

5. Two copies of the document to be evaluated (one for you and one for the participant).

6. Tapes (either audio or video). Be certain you have a backup. Test the tape(s) before collecting the protocol to be sure it is working.

7. A place to observe. The person collecting the protocol should have a place to observe, preferably a place that will not make the participant feel uncomfortable. Many evaluators prefer to sit behind a two-way mirror. If it is necessary to sit next to the participant, the chair should be positioned in a way so that the evaluator can look at the screen or document the participant is reading.

In addition, you may want to devise a preliminary coding scheme. Coding of protocols, discussed below, proceeds much more efficiently when the evaluator has at least some idea of the kinds of difficulties the document may produce. Before collecting the protocol, it is important to have already conducted a technical and stylistic review. Such reviews allow the evaluator to begin protocol-aided revision with the best draft possible, that is, one that has been checked for technical accuracy and style. In addition, these reviews often become good sources of ideas for a preliminary coding scheme, for example, errors caused by descriptions, errors caused by procedures, errors caused by poor formatting, or errors caused by missing information. Bring colored pens to mark the text for various problem types. And when possible, make a tally sheet for summarizing the various problem types. This will make evaluating your results go very quickly, but make certain you allow for the creation of new categories after seeing what participants actually do.

Collecting a Protocol

Before collecting a protocol, you will need to consider the practical issues mentioned above. In addition to providing participants with a well-written set of instructions, it is wise to play an audio or video demonstration tape of someone giving a protocol. The demonstration tape should be about two minutes in length and it should illustrate a range of positive and negative comments about the text—signs of approval, questions, confusions, predictions, elaborations, or any reading behavior. The goal is to provide participants with an example that shows them *not* "what to do or what you expect" but the range of ways people respond to texts. The aim is to make participants feel comfortable in responding with whatever comes to their mind as they are engaged in the task. The instructions you create along with a sample tape will typically be enough to make most participants feel at ease about talking aloud as they read and/or perform a task.

As you are collecting the protocol, try to catalog all you see, including nonverbal behavior. Follow along as the participant reads the text so you can mark any section that is unclear or confusing. Once a protocol is in progress, it is best if the evaluator does not intervene. If participants have questions, allow them time to figure out the answer on their own. Resist intervening unless the participant becomes frustrated and wants to stop the protocol. After the participant has completed the task, answer questions, thank him or her, and explain the project in more detail.

Transcribing and summarizing protocols. In transcribing protocols for analysis, Bond (1985) recommends the following procedure:

> Depending on your needs, you may or may not wish to have your protocols transcribed. For example, if you videotape the sessions, that may be sufficient. But if you tape record the sessions, a transcription on hard copy may allow you to more easily detect problems than just listening to the playback alone. By all means, though, if you do transcribe you protocols, you should use the hard copy transcript together with the tape, because the hard copy transcript cannot capture certain things like inflection that the tape can reveal . . . Protocols are typed as is—everything on the tape is

transcribed—every word, including curse words, and every sound (Bond, p. 330).

A less exhaustive way to summarize think-aloud protocols is to listen to the audio tape or to watch the video tape, transcribing only selected portions (comments, questions, errors) and marking the original text for the location of the occurrence. When the writer/document designer is under time pressure to complete the evaluation, this abbreviated sort of transcription may be an optimal alternative. This procedure is also appropriate when the objectives for the evaluation are quite narrow. For example, if the objective involves simply determining how participants understand the examples in a text, the transcription could be limited to those comments that occur before and after the text's examples. The output of such a transcription is an itemized list which is then ready for coding.

Diagnosing and coding problems that participants experience. While collecting and summarizing protocols is a relatively straightforward process, interpreting their results, and using the feedback for revision requires sensitivity and practice on the part of the writer. Once the protocol has been transcribed or summarized, it should be coded. In "How to Code a Think-Aloud Protocol for Functional Documents," Johnson and Schriver (1986) suggest that coding protocols with a goal to revise the document involves classifying how participants respond to discernible text features such as format, style, layout, graphics, or to various information types such as procedures, examples, definitions, analogies, cautions, conditionals, etc. This paper includes sections on "how to code user protocols," "a coding scheme for user protocols" and "summarizing and consolidating results."

The ability to diagnose and code the problems that surface in think-aloud protocols is a skill that develops with practice in evaluating many protocols. Many beginning writers and document designers have difficulties knowing how to interpret the feedback participants provide. Some types of reader feedback signal obvious problems, for example, when readers say "What does this word mean?" Writers can easily diagnose such a problem as a "missing definition." Other times, however, participants will not overtly "detect" a problem at all. Instead, they may think that their reading of the text is correct while they are in the process of completely misunderstanding it. In such cases, the writer will need to have the entire protocol transcribed. The complete transcription is needed in order to get precise information about where comprehension went astray.

In general, it is best if the person who codes the protocols is not the writer of the original text. Some writers are threatened by reader feedback or are unwilling to accept the comments participants make as signals of actual problems with their text. They may tend to attribute the difficulty to the participant rather than to the text. Other writers, however, enjoy watching participants interact with their text; they find readers' problems interesting and want to learn more about how their texts can mislead readers.

Fixing problems the text creates for participants. The last and most important stage in protocol-aided revision is fixing the problems created by the text. When the text causes few problems, writers can usually solve its problems by making deletions and minor additions. But when readers are confused by many aspects of the text, major revisions and rewriting is often necessary. It is important for writers to try to determine the locus of the problems. In this way, they will have better information about what solution strategies to employ. As mentioned above, sometimes readers will misunderstand an entire text, but the misunderstanding may arise out of one fundamental misconception that occurs early in the text. Other times, the problems will be distributed throughout the text and the reader's difficulties will escalate with almost every new idea.

Once the protocol has been coded, writers will have a better sense of which problems are most severe and/or frequent. Since most revision is done while under time pressure to finish, writers should attend to the most severe problems and should decide which problems, if any, will be left unsolved. The goal, of course, is to find solutions to as many problems as time permits.

Choosing optimal revision strategies is also a skill that develops with extensive practice. While there are no clear-cut strategies that work in every revision situation, a few key questions should initiate any revision activity:

1. What problems are created by the organization, structure, or layout of the text? Answering this question will help focus the writer's attention on the text's macrostructure. Research in text design shows that global features such as structure and levels of subordination, for example, headings and subheadings, have the most impact on the memorability of a text (Britton, 1986). Similarly, research in writing underscores that skilled revisors attend to the text's global features early in their process, and that solving high-level problems first often has the effect of eliminating lower-level problems at the same time (Flower et al., 1986; Hayes et al., 1987; Schriver, 1989a).

2. What alternative verbal or visual solutions are available? Sometimes, as is demonstrated in the case studies, a visual solution can help to solve most of the text's problems. For functional documents, visual solutions usually take one of two shapes. One way to create a visual solution lies in changing the typography, section headings, margins, rules, or layout. Another more obvious means of creating a visual solution is to supplement or substitute the text with pictures, diagrams, tables, charts, or other graphic devices.

The goal in asking these questions is to solve the text's most severe problems in the shortest amount of time. Research shows that writers who revise by adopting a sentence-level perspective of the text typically fail to make revisions that increase the effectiveness of the whole text. A sentence-level perspective is one in which revisors attack text problems linearly. They begin by reading the first sentence of the text and by asking "Is there anything wrong with this sentence?" If they find a problem, they fix it and proceed to the next sentence. The drawback of this strategy is that it blinds revisors to how the whole text is functioning and focuses their attention to word and sentence-level errors (Schriver, 1989a). While it is essential to fix local errors, it is more important and more efficient to adopt a whole-text perspective. In this way, the most pervasive problems will be dealt with first, thus allowing the solution of sentence-level problems without the possibility of wasting time fixing problems locally and then determining that the whole text needs to be rewritten.

PROTOCOL-AIDED REVISION IN PRACTICE: CASE STUDIES OF THE PROCESS

To help writers and document designers see how protocols can be used in revision, the following two case studies illustrate the process of protocol-aided revision.

Case Study 1

The first case study, "The DUC System" (Figures 1-3) comes from the beginning of a tutorial section of a computer manual on the topic of computer-aided design. The tutorial is aimed at graphic designers who are experienced in design using pen and paper

but who have no familiarity with design using a computer. Its goal is to teach new users the fundamentals of computer-aided design. The manual was written to accompany a new Design Using Computers (DUC) system, one of the early computer-aided design (CAD) systems. In 1983, this particular tutorial was being used by a CAD lab within the design department at Carnegie Mellon University to teach undergraduate graphic designers the basics of CAD systems. The director of the CAD lab asked the document design team at the Communications Design Center to revise the text because he felt the text took students too long to "get started" and that they were making errors in using the equipment. To determine the nature of the text's problems for students, document designers chose to collect user protocols to evaluate the manner in which the tutorial was being read and used. Participants who volunteered to provide user protocols were senior undergraduate design majors who had no prior experience in using CAD equipment.

Case Study 1 illustrates how protocols can help writers and document designers substitute or supplement their verbal text with visual text. It is divided into three parts:

1. the original text, "The DUC System" (Figure 1);

2. a sample user protocol from one of the inexperienced "DUC" users (Figure 2);

3. a protocol-aided revision based on the inexperienced user's difficulties with the text (Figure 3).

This case study appears as one of ten lessons in revising computer documentation for comprehension using protocol-aided revision (Schriver, 1984). Figure 2, the user's protocol, shows the variety of problems the design student had with the text. The problems he experienced while trying to use the tutorial allowed a document designer to diagnose problems of several types. First, problems that took the shape of "what" questions, signalling a call for definitions and purpose statements. For example, "What is the purpose of the light pen? What is the difference between selecting and indicating? What does TC stand for?" Second, problems that took the shape of "how" questions, signalling the need for better procedural information. For example, "How do I hold the light pen? Do I simultaneously hit both indicating and function keys? Couldn't they give me a better idea of how to hold the light pen with a drawing instead of words? Is this really a two-step action, first you select and then you indicate?" Third, problems that took the shape of "where" questions, signalling the need to clarify the location of various areas of the screen as well as where the user should look in order to get feedback and/or confirm that his actions were accurate. For example, "Where should I be looking to get the point of this information? Will the terminal always prompt me for these commands? Where exactly is the message versus the menu area? Where is the indicate function key located?" Fourth, problems that took the shape of "why" questions, signalling a call to provide more contextual information about the user's goals in invoking particular commands. For example, "Why are they telling me these commands without a context? Is there a reason to tell me the instructions without telling me when and where I will use them?"

In deciding how to the revise the tutorial, the document designer, Carol Janik, felt that the user's problems were too numerous and too severe to warrant solving the text's problems by making minor sentence-level repairs. She concluded that the user's comments suggested that the primary difficulty with the text was that it relied exclusively on a verbal presentation when a graphic presentation was needed. Thus, she tried to solve the user's questions with one major strategy, that is, changing the text from a verbal to visual presentation.

The DUC System

The Display Station

Each display station consists of a terminal with a display screen, a typewriter keyboard, a light pen, and a function keyboard.

The Display Screen

Message Area—provides feedback on the current status, e.g., function currently in use, scale of drawing, warning of invalid operation, etc.

Menu Area—provides options which you can choose with the light pen.

The Light Pen

The light pen is a device which serves two functions. You will learn how to draw points to lines to more complex objects such as circles and ellipses.

Selecting (Sel)

Selecting an item on the menu area or an element in the drawing area. Hold the pen perpendicular to the screen with the point touching the desired item and then push the pen point into the screen until the pen clicks. The terminal prompts you to select by typing Sel in the message area of the display screen.

Indicating (Ind or Tc)

Indicating an item on the drawing area of the screen. Hold the pen perpendicular to the screen at approximately the desired place and then hit the Indicate function key. The terminal will prompt you to indicate by typing IND or TC in the message area of the display screen.

Both of these functions will be covered in the first exercise.

Throughout the manual, we will designate instructions as follows:

- "Select" always applies to pushing the light pen into the screen until the pen clicks.
- "Indicate" always applies to touching the light pen to the screen at the specified place and hitting the Indicate function.

Figure 1. The original text of "The DUC System."

The DUC System

Well, if I wasn't sitting in front of this terminal, I'd never guess this stuff is about a computer-aided design system.*

The Display Station. Each display station consists of a terminal with a display screen, a typewriter keyboard, a light pen, and a function keyboard. O.k., so I'm looking at this equipment and trying to tell which is which. I've never used a function box or a light pen before. I want to try out this light pen, it looks fun to use. The only thing is that I'm left- handed and I don't know how to position my hand with all this new stuff.

The Display Screen. Well, I'll assume this means the terminal screen. Message Area—provides feedback on the current status, e.g., function currently in use, scale of drawing, warning of invalid operation, etc. I really don't know what I should be looking at here. What part is the display screen. I haven't tried anything yet so I don't know why they're telling me this detail now. I don't yet understand current status or invalid operations either. Menu Area—provides options which you can choose with the light pen. Alright, but where exactly is the menu area?

The Light Pen. What is the purpose of the light pen? The light pen is a device which serves two functions. You will learn how to draw points to lines to more complex objects such as circles and ellipses. Huh? O.k., I'm trying to learn the function of this equipment all at once because I'm eager to create my own drawings. I guess for this session, I'll have to be satisfied with the basics. From this introduction, I expect that I'll be moving from drawing points to lines to more complex elements like circles and ellipses. Ok, I'm ready. I wonder which functions they are referring to—drawing lines and circles or selecting and indicating?

Selecting (Sel). Selecting an item on the menu area or an element in the drawing area. Hold the pen perpendicular to the screen with the point touching the desired item and then push the pen point into the screen until the pen clicks. I know it says what to do, but I'm having difficulty knowing exactly how to hold this thing. How do you make it perpendicular? I don't know how hard to press and I'm afraid of damaging the screen. The terminal prompts you to select by typing Sel in the message area of the display screen. I wonder if it always prompts you?

* Underlining indicates comments made by the user.

Figure 2. A sample user protocol collected from an inexperienced user of "The DUC System."

Indicating (Ind or Tc). Indicating an item on the drawing area of the screen. Hold the pen perpendicular to the screen at approximately the desired place and then hit the Indicate function key. Where is the indicate function key located? How can I do both indicating and hitting function keys simultaneously? The terminal will prompt you to indicate by typing IND or TC in the message area of the display screen. What does TC stand for? Where is the message area of the screen? Couldn't they give me a better idea of how to hold the light pen with a drawing instead of words?

Both of these functions will be covered in the first exercise. What is the essential difference between selecting and indicating? I'm not getting this from this description. Whey are they telling me these commands without a context?

Throughout the manual, we will designate instructions as follows. Is there a reason to tell me the instructions without telling me when and where I will use them?

"Select" always applies to pushing the light pen into the screen until the pen clicks. Is this really a two-step action? First you select and then you indicate? Or are there times when I simply indicate?

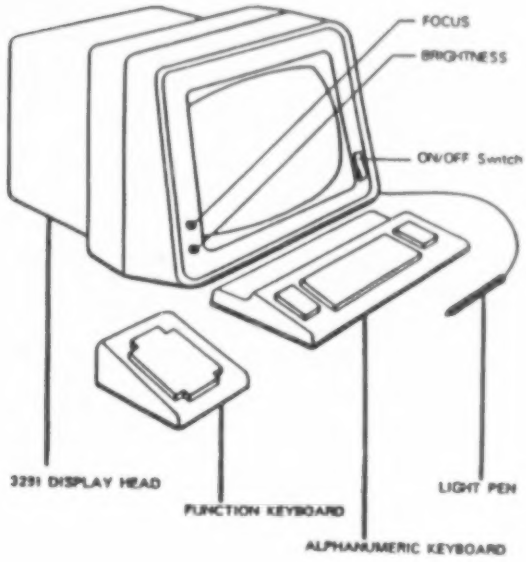
"Indicate" always applies to touching the light pen to the screen at the specified place and hitting the Indicate function. Sounds fairly clear, but I still don't know in what contexts I'd choose these. It seems odd to put them here.

* Underlining indicates comments made by the user.

Figure 2 (continued). A sample user protocol collected from an inexperienced user of "The DUC System."

The Display Station

Each display station consists of a terminal with a display screen, a function keyboard, a typewriter keyboard, and a light pen. If you are right handed, it is usually best to hold the light pen in your right hand and position the function keyboard on your left. If you are left handed, do the opposite.



The Light Pen

The light pen serves two functions:

- selecting a graphic element (such as a point, line or circle) on the screen or an item on the menu (a list of options on the screen)
- indicating an element, an area, or a direction on the screen.

You will learn how to use the light pen in both of these ways on pages 23 and 39 of Exercise One.

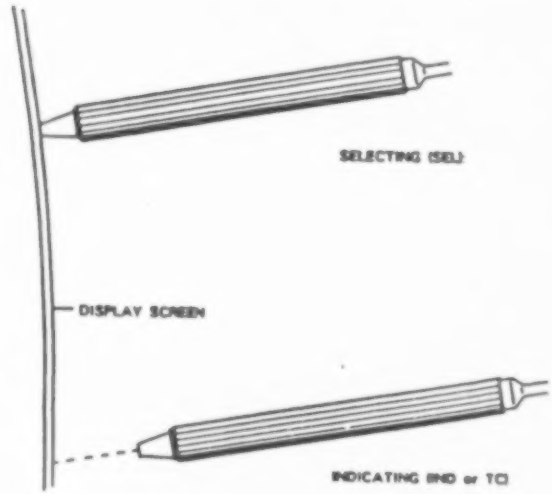


Figure 3. A protocol-aided revision for an inexperienced user of "The DUC System."

Tips On How To Use This Manual

The symbols below are used throughout this manual to represent areas of the display screen. We describe each area in detail after you login.

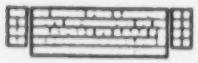
This symbol is used to represent the message area.

This symbol is used to represent the drawing area.

This symbol is used to represent the menu area and the typing area.

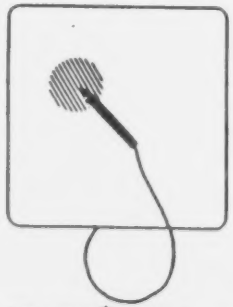
The following symbols are used to represent parts of the DUC equipment.

This symbol is used to represent the typewriter keyboard. When this symbol appears in the manual, the key you are to hit will be shown in black.

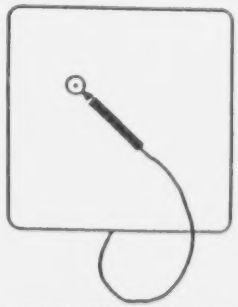


This symbol is used to represent the function keyboard. When this symbol appears in the manual, the key you are to hit will be shown in black.

These symbols are used to represent actions with the light pen.



This symbol ▨ means that you should indicate with the light pen in that approximate area of the display screen.



This symbol ⊙ means that you should select with the light pen the element that is shown. The circle is to help you locate the element; it does not appear on the display screen.

Figure 3 (continued). A protocol-aided revision for an inexperienced user of "The DUC System."

Janik rewrote the text (shown in Figure 3), starting by creating a diagram designed to answer the user's question about the equipment and "how to hold the light pen." The revision eliminates most of the reader's problems by including a drawing of how to position the light pen in relation to the display screen. The revised information on the light pen specifies its basic functions and then previews that readers will learn to use the pen later in the first exercise. Since users need to know information about other system functions and procedures, such as logging on and using the function keyboard, *before* they can actually begin to draw, the revisor separated the information accordingly. The revisor also adopted graphic conventions for the meanings of "selecting" and "indicating"—conventions that were used throughout the manual.

Janik's primary goal during revision was to make the text's organization more transparent. To do so, she reorganized the text, changed the page layout, and divided the information into manageable chunks for the reader. She also aimed to provide the reader with a better sense of the consequences of specific actions. The revision tells the reader specifically that selecting relates to points, lines, or circles while indicating is used for elements, areas, or directions on the screen.

Case Study 2

The original text, "The Art of Bird Watching," (Figure 4) is part of a brochure that was distributed to visitors at a nature conservancy in northeastern Pennsylvania. From the conservancy's point of view, the aim of the brochure is to provide useful information to both newcomers and experienced bird watchers. People who work at the conservancy are enthusiastic about helping visitors, whether inexperienced or experienced in bird watching, to get the most out of their visit and make them feel part of a growing community of people who love birds. The manager of the conservancy believed that it was important that

The Art of Bird Watching

There are over 800 species of birds representing over 60 families of birds in North America. Bird Watching or birding is becoming very popular in North America. Birding is an art. To become a birder involves developing your own techniques for identifying species of birds. When you go birding, quick and reliable identification of birds species is essential. To identify birds, compare the form of a typical bird in a particular group to birds with similar silhouettes. At first glance, note the invariable features: range, shape, behavior, and voice. Take a journal and make notes that will help you develop your own system for recalling the important species' characteristics. Try to determine a bird's particular features and attributes before you look at a field guide for the answer. In time, you will be able to identify birds by their features and attributes with only a glimpse. The better you get a recognizing patterns related to flight, walking, feeding, courtship, nest-building, and care for the young, the more skilled you will become at identifying species of birds. Spend time studying books and looking at birds in the field. As you become more experienced, you will find the birding technique that works best for you.

Figure 4. The original text of "The Art of Bird Watching."

everyone who visited get a good impression and want to come back, but he was uncertain about how well the brochure was meeting the needs of the various visitors.

To determine the effectiveness of the brochure for both audiences, protocol-aided revision was employed. Reading protocols were collected from two members of the intended audience of the brochure, an inexperienced bird watcher (Figure 5) and an experienced "birder" (see Figure 7). The inexperienced bird watcher was a twenty-year-old man from Philadelphia whose friends had invited him to the nature conservancy. He was somewhat skeptical about the idea of going bird watching. He said that he enjoyed getting

The Art of Bird Watching

There are over 800 species of birds representing over 60 families of birds in North America. That's a lot. I had no idea there were so many. Bird Watching or birding That's a funny word . . . birding . . . are they serious? is becoming very popular in North America. Birding is an art. An art of what—just watching birds? To become a birder Oh no, a birder? I'm not really into being that . . . sounds a little kinky to me, involves developing your own techniques for identifying species of birds. Like what? When you go birding, When I go birding, hmm . . . this is strange . . . quick and reliable identification of birds species is essential. I thought you just looked at the birds. I didn't know you had to figure out species. Sounds hard. Maybe I'll just have my friends show me. To identify birds, compare the form of a typical bird in a particular group to birds with similar silhouettes. Well, that would be nice, but how do I know what's typical? What do they mean by silhouettes—heads or beaks? I can't really picture this too good. I could probably recognize pigeons, robins, and maybe bluejays. Oh, and I've seen a lot of seagulls at the Jersey shore. At first glance, note the invariable features: Say what? This is getting beyond me ya know, range, Range . . . is that the length between the beak and the tail? I think I read that somewheres, shape, behavior, and voice. Voice, I guess bird song. That part sounds easy. Take a journal Where? and make notes that will help you develop your own system for recalling the important species' characteristics. They've gotta be kidding, taking notes. Are you supposed to be Joe-Thoreau? This is too much for a boy from south Philly. Try to determine a bird's particular features and attributes What's the difference between features and attributes? before you look at a field guide What field guide? for the answer. In time, you will be able to identify birds by their features and attributes with only a glimpse. Sure I will. The better you get a recognizing patterns related to flight, walking, feeding, courtship, nest-building, and care for the young, the more skilled you will become at identifying species of birds. I wouldn't know what patterns to look for. Spend time studying books Like what? Are they trying to sell me something here? and looking at birds in the field. As you become more experienced, you will find the birding technique that works best for you. And if you're lucky, they'll put you on one of those public TV on one of those nature shows. Sounds like it could be fun, I think.

Figure 5. A sample reading protocol collected from an inexperienced bird watcher.

out of the city and said he might learn something new. The expert bird watcher was a thirty-four-year-old woman from Lancaster, Pennsylvania who had been a member of the Audubon Society for ten years. She was a birding enthusiast and had traveled across the U.S. and Canada on "birding" camping trips. Figures 5 and 7 are excerpts from their protocols. The passage being read (Figure 4) comes from the beginning of the brochure.

From the writer's perspective, the most interesting aspect of these protocols is that the two readers bring entirely different topic knowledge and expectations to bear in understanding the brochure. The first conclusion the revisor drew from the protocols was that the text was too difficult and vague for the inexperienced bird watcher and too elementary for the expert. The revisor decided that it would be very difficult to satisfy the diverse needs of both audiences in one brochure and requested permission from the director of the conservancy to create two brochures.

The reading protocol of the inexperienced bird watcher shows that he misunderstood what is involved in bird watching, thinking that it is just looking at birds. The protocol shows that he lacks knowledge about the meanings of "silhouette" and "range." He oversimplifies the complexity involved with identifying bird songs and dismisses the idea that taking notes might be useful. His protocol also reveals that he does not understand the difference between features and attributes. In addition, he misinterprets the conservancy's motive in suggesting that he look at a field guide, characterizing the suggestion as a sales pitch. Another major problem the protocol illustrates is that the reader was unable to act on the advice "to compare the form of a typical bird in a particular group to birds with similar silhouettes" because he did not know what a silhouette was. The inexperienced reader, then, missed the main point of the brochure.

In response to the reader's difficulties, the revisor chose to supplement the text with examples of typical silhouettes of common bird families (see Figure 6). The revisor decided that the original text included too many references to unexplained bird features such as range, shape, behavior, and voice, and that focusing on one relatively simple feature such as shape would be more informative to a beginner. The revisor felt that more simple descriptive and procedural advice was needed on how to begin recognizing the general shape of families. In contrast to the original text, the revised text recommends that the inexperienced bird watcher take a "staged approach" to becoming more experienced.

In the rewrite, the writer tried to explain more clearly why a journal and a field guide are useful. The revision also mentions a particular field guide. Moreover, in concluding the new version, the writer focuses on getting newcomers excited about birding rather than on developing their own unique techniques.

In contrast, the experienced birder's protocol (Figure 7) shows that the information in the original brochure is insufficient and in some places, misleading. The experienced birder finds incomplete information concerning birding as an art, methods for identifying birds, field marks and their use in identifying birds, kinds of books that provide information on birds, birding in various parts of the country, and ways to identify similar species of birds. In addition, she feels the brochure makes birding appear much simpler than it is. Her protocol reveals that she finds the information on how to "note the invariable features" to be misleading. The experienced birder's final comment raises the issue that "distinguishing among similar species" is perhaps the central skill in birding—a point the original brochure fails to make in a clear way.

To solve the problems in the text detected by the expert, the writer decided to focus the revision on ways to develop expert birding skills (see Figure 8). In so doing, the writer (who was not an expert bird watcher) consulted the director of the conservancy and the

The Art of Bird Watching

It is not surprising with over 800 species of birds representing over 60 families in North America to find that bird watching or "birding" has become very popular in the United States. Birding is the art of observing and studying different species. To identify birds quickly and reliably will take considerable practice. Before you go birding for the first time, buy a field guide which provides descriptions, photos, and silhouettes of birds. Beginning "birders" usually identify bird families by comparing birds they see with the illustrations or descriptions in a field guide. Study the silhouettes. Once you are able to recognize the general shape of a family, you will be able to identify a member from its shape alone. The warblers, tanagers, cardinals, sparrows, and finches shown on this page make up one of the many families you can learn about in this way.

Warbler

Tanager

When you go out in the field, take both a field guide and a journal for making notes about the birds you see. Try to identify the family and the bird's particular features before consulting the field guide. As you become more experienced, you will be able to distinguish families by recognizing distinctive behavior patterns such as flight, walking, feeding, courtship, nest-building, and care of the young.

Cardinal

At first, you will not be able to identify all of the particular characteristics of a species such as an American Goldfinch. Gradually, you will get better at identifying the features that distinguish one species from another–features such as shape, voice, behavior, and color. Spend time studying books (such as A Field Guide to Birds of North America, Golden: 1966) and looking at birds in the field. As you become more experienced, you will discover the excitement of identifying a species for the first time and you will realize why so many people have become enthusiastic birders.

Sparrow

Finch

Figure 6. A protocol-aided revision for an inexperienced bird watcher.

The Art of Bird Watching

There are over 800 species of birds representing over 60 families of birds in North America. That's a recent classification scheme, people actually believed there were many more than that in the 60s. At that time, many species were poorly understood and sometimes males and females of the same family were considered different species. Bird Watching or birding is becoming very popular in North America. It's been very popular in the U.S. for at least forty years. Birding is an art. Of course it's an art, but it needs to say why. Because birding is very sophisticated these days. Birders use all kinds of ways to identify species. Birding was originally associated with the sport of killing birds. To become a birder involves developing your own techniques for identifying species of birds. When you go birding, This is oddly phrased, it's not like going skiing. quick and reliable identification of birds species is essential. Obviously. To identify birds, compare the form of a typical bird in a particular group to birds with similar silhouettes. This must be for a beginner, it's a much more complex process than that. At first glance, note the invariable features: range, shape, behavior, and voice. That's sensible advice although one does not note the range by looking at a bird. It shouldn't say 'at first glance' either . . . they make it sound so easy . . . just take a quick look and note what you see . . . this is misleading. Take a journal and make notes that will help you develop your own system for recalling the important species' characteristics. Try to determine a bird's particular features and attributes before you look at a field guide for the answer. The field guide doesn't always match what you see, but that's a good idea for beginners. I agree it's important to develop you own system and style of birding. But birders should also use the well known field marks that anyone can learn. In time, you will be able to identify birds by their features and attributes with only a glimpse. The better you get a recognizing patterns related to flight, walking, feeding, courtship, nest-building, and care for the young, the more skilled you will become at identifying species of birds. Okay. Spend time studying books and looking at birds in the field. It doesn't say what kind of books. What about magazines? What about birding in different parts of the country? That's what I like. As you become more experienced, you will find the birding technique that works best for you. This brochure is not that useful for me. I find it somewhat misleading and too general. It would be nice to discuss ways to identify similar species of birds . . . that's what birding is all about. But maybe I'm asking too much for a brochure.

Figure 7. A sample reading protocol collected from an experienced bird watcher.

The Art of Birding

It is not surprising with over 800 species of birds representing over 60 families in North America to find that birding has become very popular in the United States. Birding, the art of using color, pattern, shape, size, voice, habitat, and behavior to identify species has become increasingly sophisticated. Birders are continually finding new ways to distinguish similar species and to identify new species. To become an expert birder will require that you master the fundamental skill of identifying field marks quickly and reliably. Visiting museums and reading books are excellent ways to study field marks before attempting to do so while observing birds in motion or in flight.

To identify birds in the field will demand that you use all clues you know about a species' primary characteristics and features, e.g., size, shape, color, pattern, voice, habitat, and range. You will need to consider a number of attributes that together give a species a distinctive personality. Skilled birders usually attend to the species invariable characteristics such as shape, voice, behavior, and range.

At first, you will need to spend considerable time studying the variety of birds of the same species. Next, you will need to study the differences between birds that appear to be similar. For example, even among the closely related species, there may be differences in posture: Yellow-crowned Night-herons often stand in a more upright posture than do Black-crowned Night-herons, and Rough-legged Hawks often perch in a more horizontal posture than do Red-tailed Hawks (see the drawings below).

Rough-legged Hawk

Red-tailed Hawk

Expert birders also watch for behavioral patterns of flight, walking, feeding, courtship, nest-building, and care of the young. Some behavior clues are obvious, like the big, splashy dives of Northern Gannets and Ospreys, or the mothlike flight of a Common Poorwill. Others are more subtle, such as the flight mannerisms of kittiwakes or the wing and tail flicks of flycatchers.* Time spent studying books such as the Audubon Society's three volume set, The Master Guide to Birding, will be well worthwhile. The Audubon magazine or journals such as American Birds or Birding are also extremely informative sources of up-to-date information. Perhaps the best way to sharpen your skills and increase your expertness as a birder is to get plenty of experience in birding in a variety of terrains, ranges, and seasons.

* These behavior clues are cited in the Audubon Society's Master Guide to Birding, Volume 1: Loons to Sandpipers, (Knopf: New York: 1983, pp. 20-22). For more information, consult this excellent three volume set.

Figure 8. A protocol-aided revision for an experienced bird watcher.

Audubon Society's Master *Guide to Birding* (Farrand, 1983). The revisor chose "posture in hawks" as a means to demonstrate how a feature such as posture can be used to distinguish among species. The writer purposefully chose an example which could be illustrated, thus adding visual support to the point about using features to discriminate among species. In addition, the revisor included details that are missing in the original—details that the expert seemed to expect, such as why birding is becoming sophisticated; why learning field marks is a fundamental skill; how behavior clues vary from obvious to subtle; and why birding in various terrains, ranges, and seasons is a way to sharpen skill. Overall, the revision assumes that the reader is an experienced bird watcher who would like to become an expert.

This case study is intended to illustrate how experienced and inexperienced audiences may require texts that contain functionally different kinds of information. In the revision for the inexperienced birder, the silhouettes are provided to help newcomers understand the need to gain skills in recognizing shapes of birds. In the revision for an experienced birder, the drawings of the hawks are intended to illustrate the importance of using features to distinguish similar species. Moreover, this case study shows how protocols can help writers select revisions that are tailored to the reader's particular topic knowledge and skill level.

A PROCESS MODEL OF PROTOCOL-AIDED REVISION

As a way to help writers use protocols to guide revision, Figure 9 presents a process model of protocol-aided revision. The model is intended to help writers/document designers see the relationship among three components: (1) cognitive processes in protocol-aided revision, (2) writer/document designer activities while engaged in these processes, and (3) outputs of processes and activities. The first column, cognitive processes in protocol-aided revision, is influenced by the revision model designed by Hayes, Flower, Schriver, Stratman, and Carey (1987), first published in Flower et al. (1986). This model is designed to capture the cognitive processes involved in using protocols to revise. Protocol-aided revision, like other sorts of text revision, involves four key subprocesses:

1. *Task Representation*—the process of representing the text's goals, constraints, and criteria for success;

2. *Detection*—the process of seeing or noticing problems;

3. *Diagnosis*—the process of characterizing or describing what the problem is; and

4. *Strategy Selection*—the process of choosing methods for solving identified problems.

Within each of these subprocesses, writers have a variety of options. The ability to exercise these options and the ability to choose and carry out effective revisions has been shown to distinguish experienced from inexperienced writers.

Protocol-aided revision is different from typical revision (that is, revision that does not rely on protocols) in several important ways. In protocol-aided revision, the subprocesses are invoked in a more sequential manner than in typical revision. In typical revision, writers have considerably more flexibility in whether they engage in the subprocess of diagnosis. Writers under normal circumstances sometimes make revisions based on "gut reactions" to the text, such as when the writer says "I am not sure what is wrong with this section of the text, but I do not like it and will rewrite the whole section." In this case, the writer detects the problem and without diagnosis, moves directly to

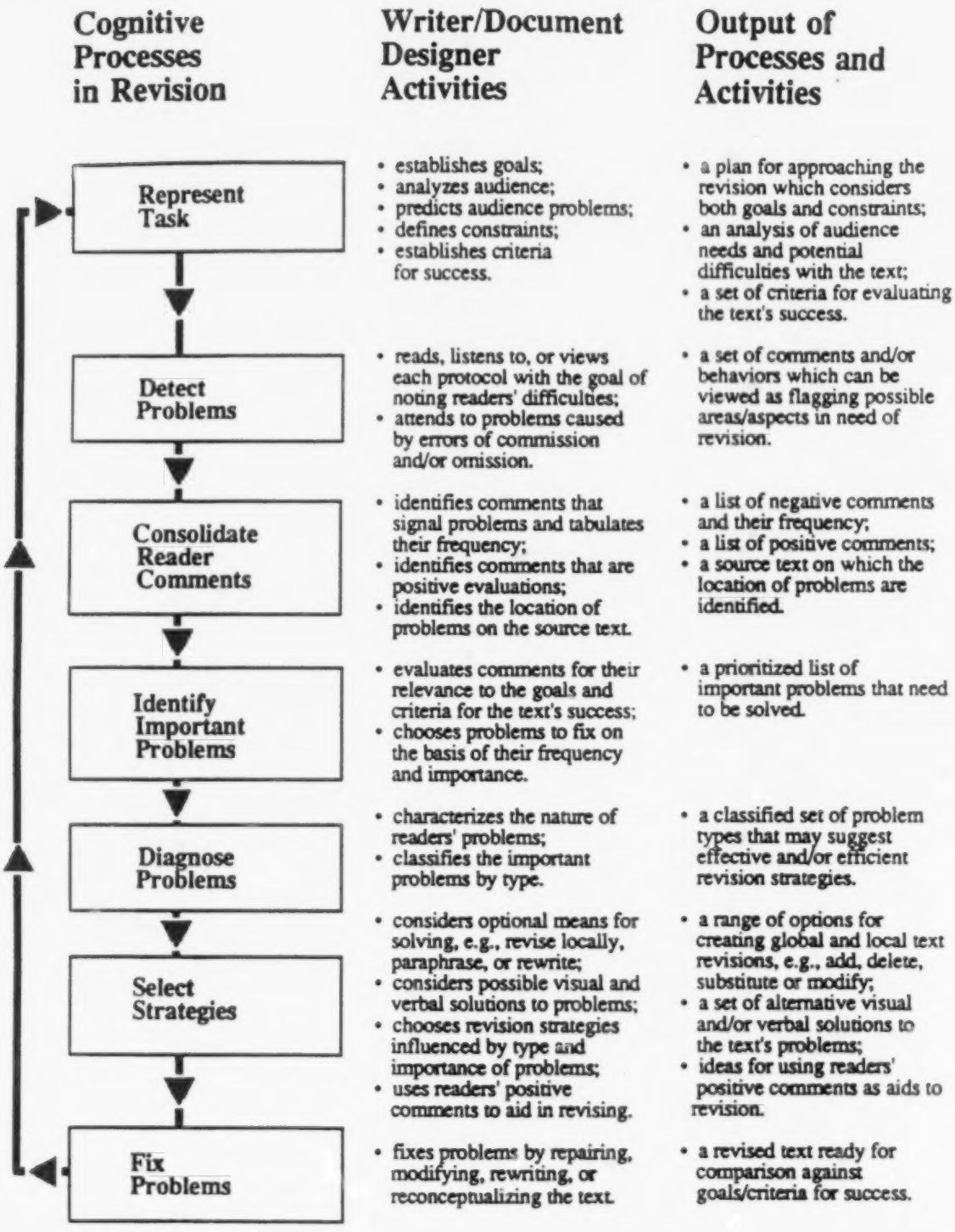

Cognitive Processes in Revision
Writer/Document Designer Activities
Output of Processes and Activities
Represent Task
• establishes goals;
• analyzes audience;
• predicts audience problems;
• defines constraints;
• establishes criteria for success.
• a plan for approaching the revision which considers both goals and constraints;
• an analysis of audience needs and potential difficulties with the text;
• a set of criteria for evaluating the text's success.
Detect Problems
• reads, listens to, or views each protocol with the goal of noting readers' difficulties;
• attends to problems caused by errors of commission and/or omission.
• a set of comments and/or behaviors which can be viewed as flagging possible areas/aspects in need of revision.
Consolidate Reader Comments
• identifies comments that signal problems and tabulates their frequency;
• identifies comments that are positive evaluations;
• identifies the location of problems on the source text.
• a list of negative comments and their frequency;
• a list of positive comments;
• a source text on which the location of problems are identified.
Identify Important Problems
• evaluates comments for their relevance to the goals and criteria for the text's success;
• chooses problems to fix on the basis of their frequency and importance.
• a prioritized list of important problems that need to be solved.
Diagnose Problems
• characterizes the nature of readers' problems;
• classifies the important problems by type.
• a classified set of problem types that may suggest effective and/or efficient revision strategies.
Select Strategies
• considers optional means for solving, e.g., revise locally, paraphrase, or rewrite;
• considers possible visual and verbal solutions to problems;
• chooses revision strategies influenced by type and importance of problems;
• uses readers' positive comments to aid in revising.
• a range of options for creating global and local text revisions, e.g., add, delete, substitute or modify;
• a set of alternative visual and/or verbal solutions to the text's problems;
• ideas for using readers' positive comments as aids to revision.
Fix Problems
• fixes problems by repairing, modifying, rewriting, or reconceptualizing the text.
• a revised text ready for comparison against goals/criteria for success.

Figure 9. A process model of protocol-aided revision.

selecting a revision strategy. Writers who are using protocol-aided revision may collect participant feedback in which the participant expresses much the same "I don't like it" sentiment about the text. However, instead of moving directly to strategy selection, the writer must pause and try to figure out why the reader is having the problem and what the nature of the problem is. While the writer using protocol-aided revision is not always able to diagnose the participant's problem, attempting to do so is important in determining if the problem is one that other readers may experience and in deciding if the problem needs to be solved.

Protocol-aided revision is unlike other sorts of revision in that reader feedback guides the process of representing problems in the text. Under typical circumstances, detecting and diagnosing problems is constrained by the writer's comprehension and evaluation process. Since most writers who use protocol-aided revision collect feedback from more than one reader, the model accounts for how writers use the feedback from multiple readers and how writers make decisions about what problems to revise. Thus, the model includes the subprocesses of *consolidating readers' comments* and *identifying important problems*. The subprocesses are hierarchically organized and are intended to illustrate one complete cycle of protocol-aided revision. The model aims to underscore the recursive nature of protocol-aided revision, showing that writers must judge the effectiveness of any revision against the goals and criteria they establish for the text's success.

A *task representation* is a set of goals and criteria which the writer uses to guide the revision process and to evaluate the final product. The writer represents the task by considering issues such as: the document's goals (such as to instruct or persuade); the audience's needs (for example, to use the text to learn a new procedure or to make a decision based on the text's content); the audience's potential problems with the text (for instance, they may fail to understand the procedures or could misinterpret the content of the text); and, the inevitable constraints under which revision must take place (that is, lack of time and resources).

These considerations will provide the writer with information that is important in designing an evaluation using protocol-aided revision. With information derived from representing the task, the writer can decide between a reading or a user protocol, determine the section(s) of the text to evaluate, select participants for the protocol task, and create instructions for the protocol task.

But more importantly, task representation provides the writer with two sorts of plans. The first is a plan for carrying out the revision, that is, a plan for attacking the text's problems, constructed in light of both goals and constraints. The second is a plan for evaluating the text's success, often stated in the form of cognitive or affective goals for the reader's interaction with the text. Unlike writers who are revising a short story or an argument, document designers are usually in the position to articulate their goals in a precise manner. Document designers can specify both affective and cognitive goals for the audience of the text in advance. An example of an affective goal for the reader might be "to have a positive attitude about learning to use an online help system." A cognitive goal might be that new users of the online help system will be able "to access the help system and use a tutorial within one hour with a 95% accuracy rate in issuing commands." When the criteria for a document's success are well specified, writers/document designers can have a clear sense of the aim of their revision activity. Articulating the criteria for success also provides explicit guidance about how readers should respond to a text before it is accepted as "the final version."

The second subprocess, *detection*, or the process of seeing problems in text, is a fundamental revision skill because if the writer never sees problems in the first place, nothing gets revised. Writing instructors agree that teaching detection skills is very difficult, and that better ways are needed to help writers see problems in text.

Detection is a skill that seems to vary depending on authorship and knowledge. Research shows that difficulty in detecting problems in texts depends, in part, on whether revisors wrote the text themselves or whether it was created by a writer different from the revisor. Writers typically have more difficulty seeing problems in their own text than in those created by someone else (Bartlett, 1982; Hull, 1984). Writers are often too close to the intended meaning in their text to see it as representing anything less than their intentions. They often view their text as communicating more effectively than it actually does for the intended reader. Consequently, authorship of the text, that is, whether the writers are revising their own or someone else's text, is an important factor determining success in revision.

Another barrier to the success of the detection process is topic knowledge. Research shows that writers with substantial topic knowledge of the text's main ideas often have significant trouble in detecting problems that their documents create for readers without such knowledge (Bond et al., 1980; Hayes et al., 1986; Schriver, 1987). Bond et al.'s study, for example, asked legal professionals to revise a loan application for the small business administration and found that professionals in law had difficulty detecting problems and limited the focus of their revisions to minor editing changes. Readers who tried to fill out the loan applications revised by legal professionals found them hard to use and confusing.

In "If It's Clear to Me, It Must be Clear to Them," Hayes, Schriver, Blaustein, and Spilka (1986) describe "the knowledge effect" in writing and how topic knowledge prevents writers from seeing problems in text. Topic knowledge was found to act as a "blinder" to text problems. High-knowledge revisors tended to overestimate their audience and believed that what was understandable to them would be clear to anyone.

Similarly, in a study of teaching writers to predict reader's needs, I found that upperclass undergraduate writers with basic knowledge of word processing were extremely insensitive in their ability to predict problems that freshman users would have with poorly-written word processing manuals (Schriver, 1987, 1989a). The knowledge effect, then, may be the unseen culprit behind why "high-knowledge experts" such as lawyers, doctors, computer scientists, engineers, economists, and government representatives frequently produce incomprehensible texts. It may also provide a clue as to why so many university professors have difficulty in communicating "the basics" to freshmen in introductory college courses.

An implication from the research in detection is that writers who are revising their own text and who have high topic knowledge may be at a considerable disadvantage in seeing the problems the text may create for readers. One of the most important cognitive advantages of protocol-aided revision is that it provides a method for "getting around" the effects of knowledge and authorship. *Unlike standard revision procedures which place the responsibility of detecting problems on the writer, protocol-aided revision places the burden of detection on the reader.* Detection of text problems is carried out while readers are engaged in trying to understand and/or use the document. The reader's comments, questions, rereadings, and hesitations can be viewed as flagging possible problems. Very often, the protocols will help writers detect both problems of commission, that is, problems caused by what the text says, and problems of omission, that is, problems caused by what the text is missing (Schriver, 1987).

In protocol-aided revision, the writer/document designer *detects problems* by reading, listening, or viewing the audio/video tapes and transcripts, making notes about what readers say or do. The writer's goal during detection is to notice all problems the text creates for readers. While not all problems readers detect will be useful in revising the text, it is unwise to throw out or ignore any problems before evaluating all participants' comments as a group, thus allowing one to see patterns of error.

Once possible problems areas have been detected, the writer/document designer is faced with the somewhat mundane yet necessary evaluative process of *consolidating readers' comments* across all protocols. Consolidation of readers' comments should be done in two complementary ways. The first involves simply identifying the location of text areas where readers experience problems. This can be done by underscoring the problem areas directly on the "source text" and placing a tally below the text region for each reader who shares the problem. But this kind of consolidation provides writers with only a partial representation of the text's problems. Many times, it is not possible to locate problems in a precise way; problems are often distributed over whole sections of text. For this reason, it is important to consolidate readers' comments as well as to record locative information about problems.

The second kind of consolidation, then, involves using the individual protocol transcripts or the itemized "reader comment lists" (discussed earlier) to create a master list of problems across all participants. This list should summarize all candidate problems for revision and tabulate their frequency. In making this list, the writer must evaluate each comment for its relevance to the document's goals and criteria for success. This aspect of consolidating readers' comments draws on the evaluator's skill in recognizing comments that signal problems that should be dealt with. Writers who have not used protocols to revise their texts often have difficulties with recognizing (and as mentioned earlier, sometimes with accepting) the problems readers experience.

Along with listing what readers disliked or had problems with, it is a useful strategy to list those aspects of the text that readers liked and had no problems with. While protocols mainly provide information related to comprehension and use difficulties, readers sometimes comment on what they like about the text. When this occurs, writers should ask themselves, "What am I doing right?" "Can this successful part be repeated or done better?" Quite often, the successful parts of the text can be amplified or used as a model for less successful parts. Another indirect way to find out what is successful about the text is to examine the protocols for areas where participants say very little. Such areas usually indicate that readers understand and can use the text with little effort. Writers may want to try to figure out what is behind readers' effortless comprehension and use of the text.

The next process in protocol-aided revision involves *identifying the important problems* to attend to. Given the typical constraints under which writers revise, they must give priority to a subset of the text's problems. In identifying important problems, the writer isolates those problems which most inhibit the text's success. The output of this activity is a prioritized list of problems that, if solved, will move the text closer towards meeting its criteria for success.

After problems to be revised are determined, *diagnosis*, the process of characterizing the nature of the problem, becomes important. In diagnosis, revisors must answer: "What is the cause of the reader's problem?" Isolating the origin of the problem is usually much of the work in finding its solution. Some problems require minimal, if any, active diagnosis. Recognizing and classifying problems such as spelling, punctuation, or grammar become highly automated for experienced writers and editors. Ideally, the text

should be free of such low-level problems before protocol-aided revision begins. Other less well-defined problems, however, call on the writer's interpretive and problem-solving skills. For example, the reader may say something as vague as "This information is coming out of nowhere." The revisor must interpret the cause of the problem, for example, "missing contextual information," and think of a way to remedy it, for instance, "add new text that creates a context."

There is now empirical evidence that using protocol-aided revision has benefits that extend beyond the particular revision situation. With practice in evaluating protocols of readers, writers can improve their detection and diagnosis skills generally. In a study of teaching writers to anticipate the reader's needs, I found that writers who were taught to detect and diagnose readers' problems in think-aloud protocols were significantly better at *predicting readers' problems in texts where no protocol was available* than writers who were taught with standard methods of audience analysis, such as peer critiquing methods or demographic heuristic techniques (Schriver, 1987). Writers showed dramatic improvement in their ability to predict readers' problems after their careful analysis of a sequence of lessons in protocol-aided revision (Schriver, 1984).

Writers improved most in their ability to detect and diagnose problems caused by what the text was missing—problems such as missing context, missing purposes, missing procedures. This research shows the important role that reader feedback can serve in improving writers' detection and diagnosis skills. It demonstrates writers' ability to learn about readers from observing readers and that such skills can transfer to new writing contexts. It also suggests that writers with practice in evaluating protocols are more likely to produce better first drafts because they are better able to anticipate a reader's response to the text.

Strategy selection is the act of considering optional means for solving the text's problems. Quite often, the process of diagnosing the text's problems suggests effective revision strategies. In selecting strategies, writers are influenced by the type and importance of problems. Some problems, such as lack of coherence, simply warrant more effort than others. In addition, writers are influenced by the constraints under which revision takes place. Very often, factors such as time and cost exert a major influence on our final decisions for revision. The impact of constraints on the selection of revision strategies is an important and unexplored research area in writing and document design (Schriver, 1989b). It is clear that writers need better advice on how to make design decisions under severe constraints.

During strategy selection, writers aim to identify visual and/or verbal solutions to text problems. For any solution that involves both visual and verbal text, they must also consider how best to integrate their proposed solutions. The output of strategy selection is a representation of ways to solve the text's problems—revise locally, paraphrase, rewrite, or reconceptualize.

In trying to find ideas for solving the text's problems, it can be helpful to consider readers' positive evaluations of the text. As discussed earlier, protocol participants sometimes make suggestions that can be used. More often, however, writers must use their own best judgement, drawing on all of their experience as readers and writers to make predictions about the solutions that will best meet the readers' needs. Strategy selection, then, draws on the writer's entire repertoire of writing and design skills.

After decisions have been made about what to do, the revisor can then try to *fix the text's problems* through activities such as repairing, modifying, or rewriting the text. Once the writer finishes a complete cycle of protocol-aided revision, the text should be compared

against its goals and criteria for success. The results of this comparison will tell the writer if another cycle of protocol-aided revision is needed.

IMPLICATIONS OF USING PROTOCOL-AIDED REVISION FOR WRITERS

As discussed earlier, there were at least two limitations of early conceptions of plain language. First, it tended to focus on the verbal expression of ideas, and second, it was targeted primarily at lay audiences and/or low-literate readers. The narrow focus on words and sentences drew criticism from writers and researchers who were looking for methods to revise texts for comprehensibility and usability. The goal of this paper was to extend the notions of plain language and to suggest that protocol-aided revision can help writers achieve plain language in several important ways:

1. It can help writers detect and diagnose the difficulties created by what the text says and by what it fails to say—difficulties that often inhibit intelligibility and usability.

2. It can help writers identify the need for creating visual solutions to text problems—photographs, pictures, typography, graphs, formatting, diagrams, flowcharts, and tables—and for integrating their visual and verbal decisions.

Methods such as protocol-aided revision that focus on helping writers to become more sensitive to the complex needs of their intended readers deserve careful attention and further research.

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